ENSDF Analysis and Utility Codes

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ENSDF Analysis and Utility Codes
Platforms

- Most of the programs are available for the following:
  - ANS standard Fortran 77
  - LINUX (Gnu f77 compiler)
  - OpenVMS
  - Windows 95/98/ME/NT/2000 (COMPAQ/DEC Visual Fortran)
- For LINUX, OpenVMS, and Windows, executables are also provided.

ENSDF Analysis and Utility Codes
FMTCHK — 1

- Should be run every time the ENSDF formatted file has been manually changed before executing any of the other programs.
  - All fatal errors (indicated by "<F>") should be corrected.
  - If possible, all errors (indicated by "<E>") should be corrected.
  - Warning messages (indicated by "<W>") should be checked to see if there are problems that may need correction.
  - For small input files, use of the default options is recommended.
  - For larger files, the user may wish to make several iterations, starting with fatal errors only.

ENSDF Analysis and Utility Codes
FMTCHK — 2

- Should also be run on the final version before submittal to the NNDC.
- Difficult to judge whether a message should be flagged as an error or warning.
- Some error messages are given because of the possible effects on other programs.
  - Mixing ratio is given but no associated mixed multipolarity.
  - No "FL=" given and no final levels with a certain limit or more than one possible final level based on E_{level}-E_{γ}.

ENSDF Analysis and Utility Codes
ENSDAT & TREND

- ENSDAT produces level schemes, bands, and tables in a format similar to that of the *Nuclear Data Sheets* and may be used to visual expect the results.
- TREND provides a simpler ASCII presentation of the tabular data (no PostScript printer or viewer required).
- Should be able to copy the list of keynumbers generated by ENSDAT into the clipboard and paste this into the keynumber form of the NNDC Web NSR to obtain the corresponding NSR entries.

ENSDF Analysis and Utility Codes
Adopted Levels, Gamma Datasets — 1

- Applicable programs are ADDGAM, GTOL, HSICC, PANDORA, and RULER.
- ADDGAM and PANDORA are useful in constructing the dataset.
- PANDOR used iteratively to aid in physics decisions, checking assignments, and updating source datasets based on changes in the adopted data.
- GTOL useful only in obtaining the least-squares adjustment of the level energies.
  - Matrix may occasionally be singular.

ENSDF Analysis and Utility Codes
Adopted Levels, Gamma Datasets — 2

- RULER may be used in two modes:
  - Comparison mode to provide additional information in obtaining γ-multipolarity assignments.
  - Should also be run to provide the BEλW's and BMλW's.
  - HSICC should be run before RULER.
- HSICC should be run to provide the internal conversion coefficients.
  - Note that there is no need to delete the "S G" records generated by code.

ENSDF Analysis and Utility Codes
Decay Datasets — 1

- Applicable programs are ALPHAD (for α decay), GABS, GTOL, HSICC, LOGFT (for $\beta^{\pm}/\varepsilon$ decay), RadList, and RULER.
- ALPHAD should be used to obtain the hindrance factors and, for even-even ground-state nuclei, R_0. For other nuclei, an R_0 must be supplied.
- GABS may be used to combine the data from up to three sources to obtain I_γ-normalization (NR), the branching ratios (BR), and absolute I_γ's.
  - HSICC should run on the input data or the α's from the adopted dataset should be used.

ENSDF Analysis and Utility Codes
Decay Datasets — 2

- GTOL may be used to:
  - Provide a least-squares adjustment of the level energies.
  - Check the uncertainties and placement of the γ's.
  - Obtain the intensities of particles feeding the levels.
    - Should be done before ALPHAD and LOGFT are employed.
  - May be useful in deriving I_γ-normalization (NR).
- HSICC may be used to:
  - Check experimentally measured α's against theory.
  - If the adopted α's are not used, to produce this information for the data set.

ENSDF Analysis and Utility Codes
Decay Datasets — 3

- LOGFT is required to obtain the log *ft*'s, $I_{\beta+}$ and I_{ε}, and partial electron-capture fractions.
  - Should be done before using RadList.
  - If one is not using measured intensities, GTOL should be used to obtain $I_{\beta-}$ and $I_{\varepsilon+\beta+}$.
- RadList should be used to:
  - Check the calculated energy deposited with that predicted by the Q-value and branching ratio.
  - to compare to experimentally obtained X-ray intensities
  - Unresolved discrepancies should be noted in the dataset.
  - ALPHAD, HSICC, & LOGFT should have been used before doing these checks.

ENSDF Analysis and Utility Codes
Decay Datasets — 4

- RULER may be used to check or further limit multipolarities based on other methods (*e.g.*, from experimental conversion coefficients).

ENSDF Analysis and Utility Codes
Reaction Datasets — 1

- Applicable programs are GTOL, HSICC, and RULER. For (thermal n,γ) datasets, RadList may also prove of use.
- GTOL's primary use is to do a least-squares adjustment of the level energies and to check the uncertainties and placement of the γ's.
  - If ΔE_γ's are not given and a good estimate of these cannot be obtained, it may be better to use the author's level energy values.
  - Also useful for checking for intensity imbalance problems if relative intensities are given.

ENSDF Analysis and Utility Codes
Reaction Datasets — 2

- HSICC may be used to check experimentally measured α's against theory.
  - Very useful to include α's and partial α's for (thermal n,γ) datasets.
- RadList may be used to check the energy balance of (thermal n,γ) datasets by tricking it.
  - Change the DSID on the ID record to indicate IT decay
  - Add an appropriate Parent record ($E_{level}=S_n$)
  - Add a BR of 1.0 on the Normalization record.

ENSDF Analysis and Utility Codes
Additional Notes - 1

- ALPHAD
  - For ΔR_0: Five values are calculated and reported:
    - $R_0(T_{½},E)$, $R_0(T_{½}+\Delta T_{½},E)$, $R_0(T_{½}-\Delta T_{½},E)$, $R_0(T_{½},E+\Delta E)$, $R_0(T_{½},E-\Delta E)$.
    - $\Delta R_0=\sqrt{(((R_0(T_{½}+\Delta T_{½},E)-R_0(T_{½}-\Delta T_{½},E))/2)^2 + (((R_0(T_{½},E+\Delta E)-R_0(T_{½},E-\Delta E))/2)^2)}$.
  - If either the value or the Δ for E_{parent}, Q_α, or E_{level} is non-numeric and E_α and ΔE_α are numeric, E_α and ΔE_α are used in the calculations.
    - If ΔQ_α=SY from Audi and Wapstra, the file should be edited to use the estimated ΔQ_α and the final output edited to restore SY.
  - Order of precedence for non-numeric uncertainties: limits (*e.g.*, "GT" or "LT"), "AP", "CA", and "SY".

ENSDF Analysis and Utility Codes
Additional Notes - 2

- COMTRANS
  - Should **not** be run on ENSDF or XUNDL files submitted to the NNDC.
    - ^A4 → A4 → A{-4} → a{-4}
  - Useful to run before using Isotope Explorer 2 or ENSDAT.
- FMTCHK
  - For level energies of the form X, Y, Z, *etc.* or E+X, E+Y, E+Z, *etc.*, an arbitrary energy is assigned to the first occurrence of the character based on the energy of the previous level energy. This is reported as an informational message in the report file and is used to see if the levels are in the proper energy order.

ENSDF Analysis and Utility Codes
Additional Notes - 3

- GTOL
  - If the level energies are of the form X, Y, Z, *etc.* or E+X, E+Y, *etc.*, the least-squares fit is done separately for each group of states and merged back into the final results.
    - Energy assigned for the first member of a group similar to FMTCHK
    - Used to sort the levels in the energy comparison but not used when creating the new output file.
  - If connecting information is too sparse, the matrix created may not be able to be inverted.
    - Check the report file for levels that do not deexcite and fix these levels.

ENSDF Analysis and Utility Codes
Additional Notes - 4

- Uncertainly placed γ's are ignored in the least-squares fit and the intensity balance calculations.
  - Estimate of the excitation energies of levels only connected by such transitions:
    - Remove the "?" in column 80 of the relevant gamma records
    - Add "F" in the energy fields of any connected level records which also are fed or deexcited by other γ's.
  - Estimate of the effect on the intensity balance:
    - Remove all "?" in column 80 of the gamma records.
    - Compare the original results to these to obtain an estimate
- If method 1 of Lyons is used, add comment for I_{β}, $I_{\beta+\epsilon}$, or I_{α}

ENSDF Analysis and Utility Codes
Additional Notes - 5

- HSICC
  - If E_{γ} is near the threshhold for conversion, new records are not created
- LOGFT
  - New records will not be created if there are non-numeric energies, Q-values, or associated uncertainties.
  - If Lyons' method 1 has been used to estimate the intensity, LOGFT should also be run using the original values in addition to the estimate.